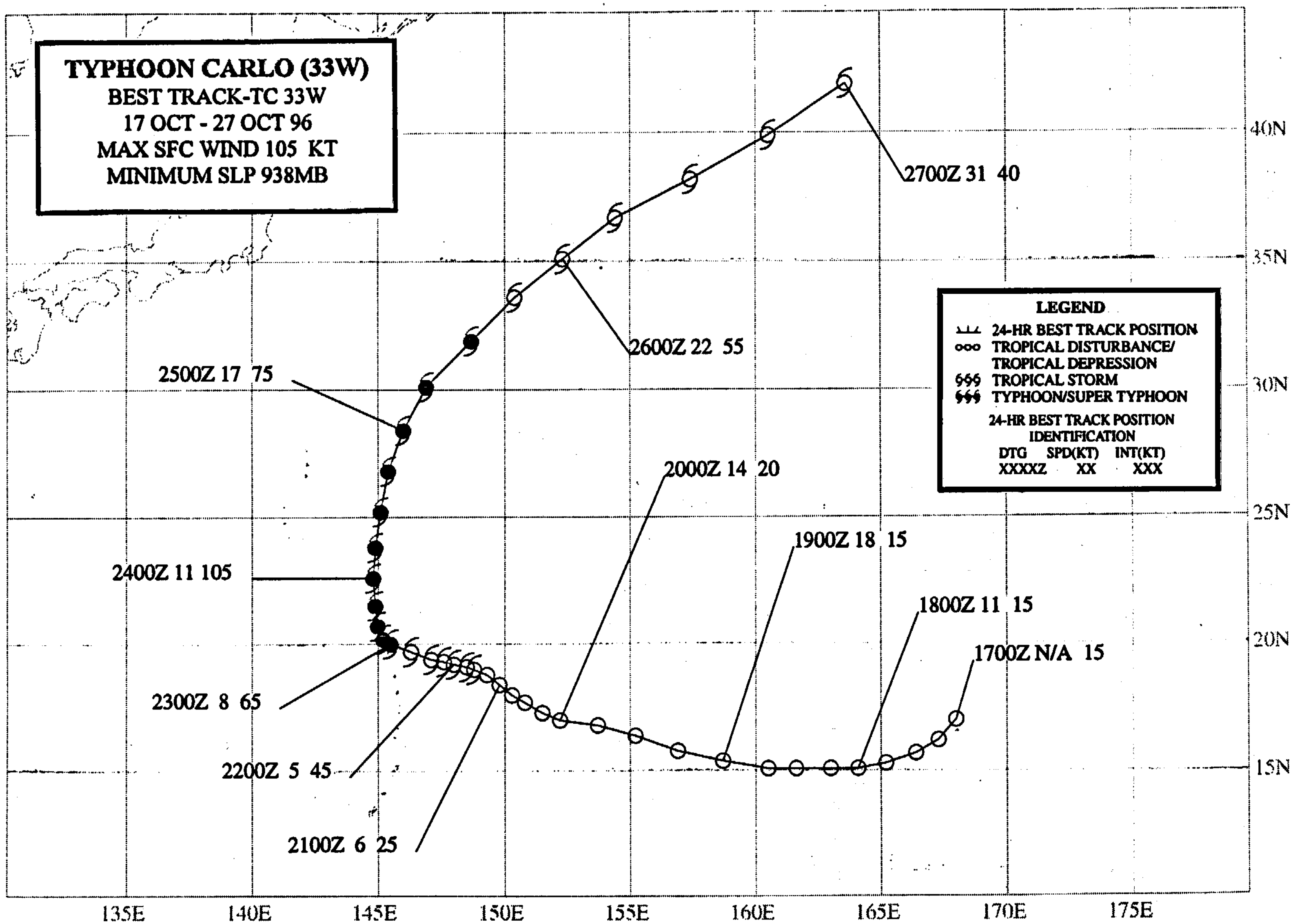
TYPHOON CARLO (33W)
BEST TRACK-TC 33W
17 OCT - 27 OCT 96
MAX SFC WIND 105 KT
MINIMUM SLP 938MB
LEGEND
24-HR BEST TRACK POSITION
TROPICAL DISTURBANCE/
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON/SUPER TYPHOON
24-HR BEST TRACK POSITION
IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XXX
2700Z 31 40
2600Z 22 55
2500Z 17 75
2400Z 11 105
2300Z 8 65
2200Z 5 45
2100Z 6 25
2000Z 14 20
1900Z 18 15
1800Z 11 15
1700Z N/A 15
40N
35N
30N
25N
20N
15N
135E
140E
145E
150E
155E
160E
165E
170E
175E

TYPHOON CARLO (33W)

I. HIGHLIGHTS

Carlo's TUTT-cell-induced formation is one of the best examples of this process witnessed during 1996. Water-vapor imagery provided detailed information on the evolution of upper-level winds, clouds, and moisture for this event. Carlo reached its peak intensity after its apparent "point of recurvature" — unusual behavior of TCs which recurve. Accelerating to a speed of 30 kt (55 km/hr), Carlo was absorbed into the frontal cloud band of an intense extratropical low.

II. TRACK AND INTENSITY

On 17 October, three TCs were active in the western part of the WNP: Abel (30W) (in the South China Sea), TD 31W (halfway between Guam and Japan), and Beth (32W) (near the coast of Luzon). Elsewhere in the tropics of the WNP, amounts of deep convection were below normal and the low-level winds were predominantly from the east. The only area of deep convection considered to have potential for TC formation was associated with a TUTT cell, and was centered near 17°N 168°E. It was first mentioned on the 170600Z October Significant Tropical Weather Advisory. Moving westward on the northern side of the TUTT cell (Figure 3-33-1), this tropical disturbance (which became Carlo) gradually became more organized. At 200230Z October, the JTWC issued a TCFA when persistent deep convection (located in a region of divergent upper-level flow) consolidated near the LLCC. Based on satellite intensity estimates of 25 kt (13 m/sec), the first warning on Tropical Depression (TD) 33W was issued valid at 210000Z.

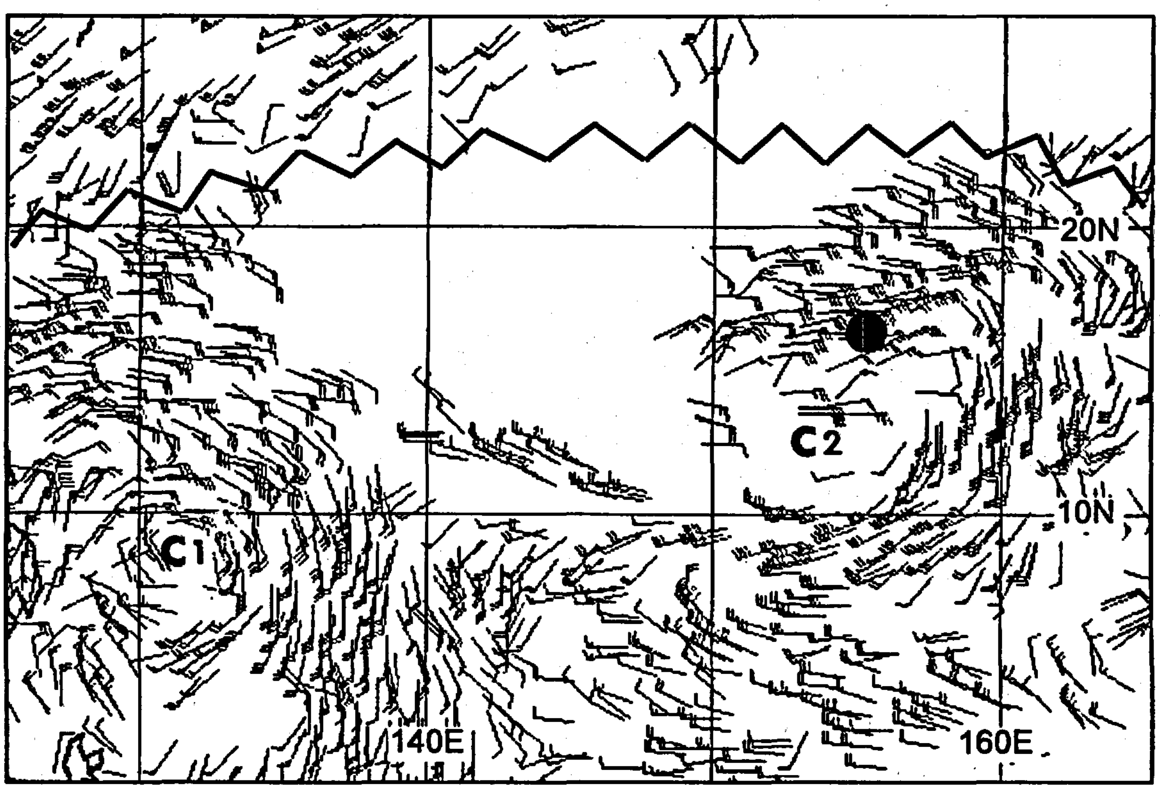

Figure 3-33-1 The location of the LLCC of the pre-Carlo tropical disturbance (shown by the black dot) is under the easterly upper-level flow to the north of a TUTT cell (labeled, C2). Another TUTT cell (labeled, C1) is located further to the west. The zig-zag line indicates the upper-level subtropical ridge axis (191025Z October GMS water-vapor winds).

Developing a CDO, TD 33W was upgraded to Tropical Storm Carlo on the warning valid at 211200Z. Carlo became a typhoon at 230000Z as a small ragged eye formed within its CDO (Figure 3-33-2). After becoming a typhoon, Carlo turned northward and further intensified, reaching a peak intensity of 105 kt (54 m/sec) at 240000Z. Late on 24 October, Carlo began a gradual turn toward the northeast accompanied by an increase in it speed of translation. Westerly shear began to affect Carlo and by 250000Z the typhoon weakened to 80 kt (41 m/sec); at 251800Z the intensity dropped to 60 kt (31 m/sec). The system continued to weaken as it accelerated to the northeast. The final warning was issued, valid at 261800Z, as the system moved northeastward at 29 kt (54 km/hr), lost its deep convection, and began to merge with a frontal cloud band.

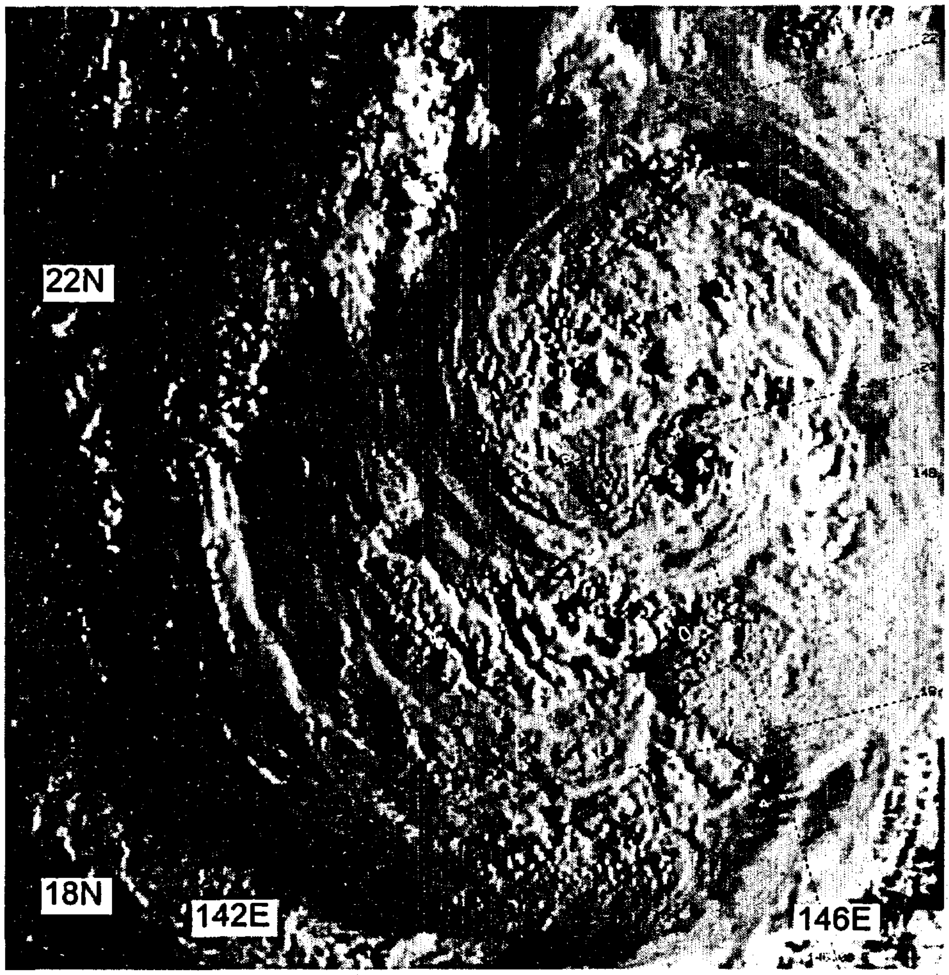

Figure 3-33-2 An overshooting cloud top casts a shadow over Carlo's incipient eye (222101Z October visible DMSP imagery).

III. DISCUSSION

a. *Tropical cyclogenesis induced by a TUTT cell*

Water vapor imagery (Figure 3-33-3) showed that Carlo formed in an area of upper-level moisture (with embedded deep convection) on the north side of a TUTT cell. Typical of TCs which form in association with TUTT cells, Carlo formed north of 15°N latitude, was embedded in low-level easterly flow, and was isolated in a cloud-minimum region south of the subtropical ridge. See Joy (12W) for a more detailed discussion of TUTT-related TC genesis.

b. *Peak intensity after making a sharp turn toward the north*

Most typhoons that undergo classic recurvature (i.e., a roughly "<"-shaped track which features initial steady west-northwestward motion, then a northward turn while slowing, followed by an acceleration toward the northeast) reach peak intensity at, or before, the point of recurvature; where the point of recurvature is identified as that point where the typhoon reaches its westernmost longitude (JTWC, 1994). Many TCs do not undergo classic recurvature. Some never recurve, while others move on a track type designated by the Japan Meteorological Agency (JMA) (1976) as north-oriented. North-oriented TC tracks have been renamed poleward-oriented tracks in Carr and Elsberry (1996) to make the concept applicable to both the Northern and Southern Hemispheres. TCs that move on north-oriented tracks move generally on long, northward paths from their genesis location and may feature large meanders and abrupt turns to the left or right (Lander 1996). North-oriented tracks occur predominantly during July through October. Carr and Elsberry found that a TC may undergo north-oriented motion for only a portion of its track — even if some, or most, of the track was of some other type (e.g., straight moving). A characteristic behavior of some TCs undergoing north-oriented motion is reaching peak intensity after acquiring a persistent eastward component of motion, but before the TC begins to significantly increase its speed of translation within the "accelerating westerlies" regime north of the subtropical ridge. Synoptic regimes associated with specific TC behavior, such as "poleward oriented" and "accelerating westerlies", are described in Carr and Elsberry (1996), and briefly at the beginning of this chapter.

Carlo reached peak intensity while moving north-northeastward on the north-oriented leg of its track. It weakened as it entered the "accelerating-westerly" regime north of the subtropical ridge.

IV. IMPACT

No reports of damage or injuries were received at JTWC.

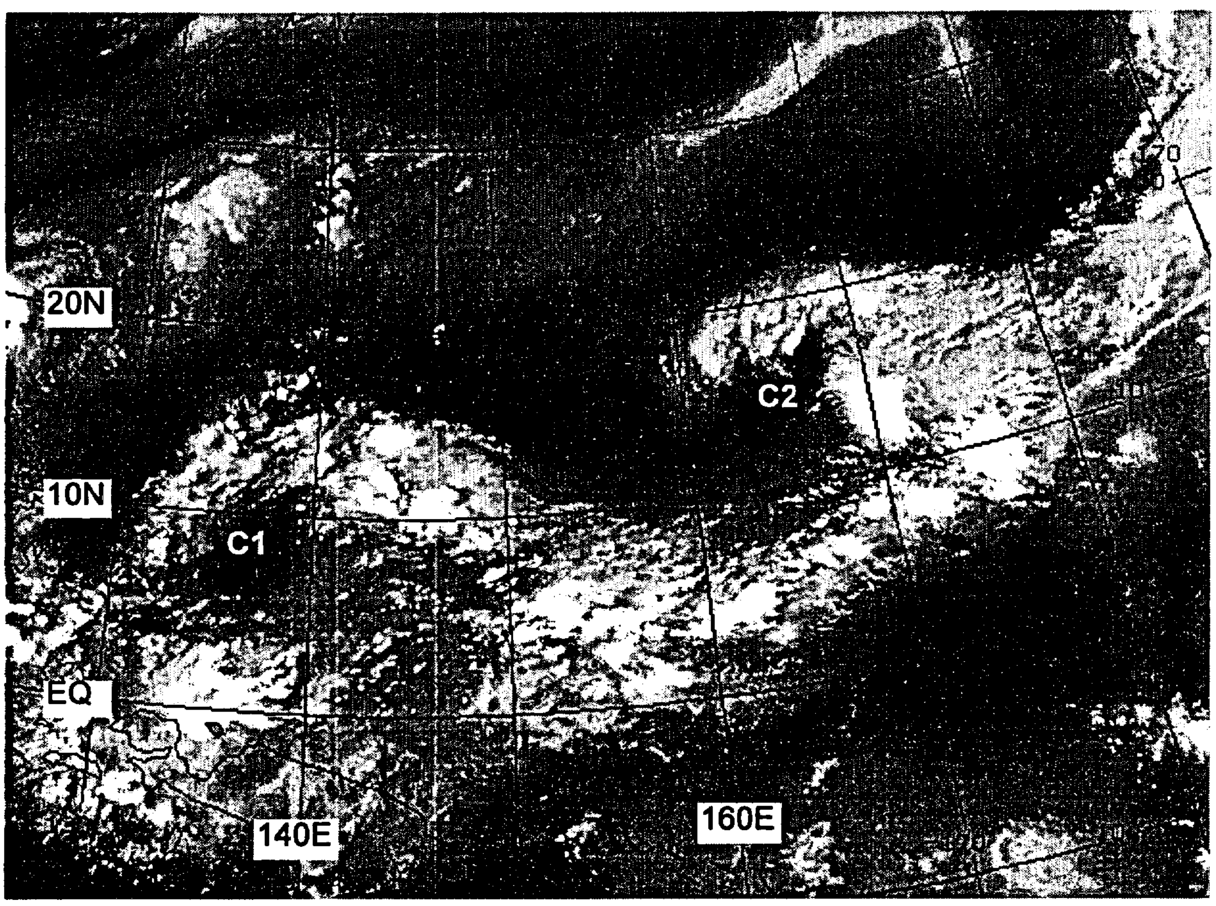

Figure 3-33-3 Two TUTT cells (C1 and C2) show prominently in water vapor imagery. Carlo formed under the moist tongue on the north side of TUTT cell C2 (180033Z October water vapor GMS imagery).